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Thermalization and dynamic phase transition of quantum spins[1]
MEHRTASH BABADI, Institute for Quantum Information and Matter, California Institute of Technology, Pasadena, CA 91125, EUGENE DEMLER, MICHAEL KNAP, Department of Physics, Harvard University, Cambridge, MA 02138 — We develop a controlled field theoretic technique for studying far-from-equilibrium dynamics of interacting quantum spins. This is achieved by combining the Majorana fermion representation of spins and 1/N expansion of the two-particle irreducible effective action (2PI-EA). We use the technique to study the relaxation dynamics of quantum spin spirals in the Heisenberg model. The non-equilibrium magnetization and spin correlations are found by solving the Kadanoff-Baym and Bethe-Salpeter equations resulting from the 1/N expansion of the 2PI-EA to the next-to-leading order. In three dimensions, we identify a dynamic phase transition in the steady state magnetization for spiral states near the Neél order. We further find a dynamical stabilization of the initial out-of-plane ordering instability in the course of the relaxation dynamics, in contrast to the linear response analysis.

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